KILLER WHALE – MONITORING AND HAZING PLAN FOR OIL SPILL RESPONSE IN WASHINGTON AND OREGON STATE

The Decision to Haze Killer Whales

This plan provides guidance relative to the monitoring and hazing activities that could be used to minimize killer whale exposure to spilled oil while conducting an oil spill response. If killer whales are observed or are likely to be in the vicinity of a spill event, the Wildlife Branch Director, with approval from NOAA Marine Mammal Health and Stranding Program, will make recommendations to the Unified Command as to which hazing technique(s) to use, or not use, at each individual spill. Contact will be made through NOAA HAZMAT division as per section 3420.1.1. The hazing methods recommended (if any) would be those that have the greatest chance of success depending on current conditions and information. Hazing and monitoring activities will be the only mitigation measures possible during an oil spill as capture and rehabilitation of killer whales is improbable. This document describes the type of monitoring and reconnaissance that is necessary to generate real time data regarding the location and activity of the killer whales. The advantages and disadvantages of numerous hazing techniques are also discussed in this plan.

Background

The Southern Resident killer whale (SRKW) population is listed as endangered under the U.S. Endangered Species Act (ESA). Oil spills have been identified as a primary threat for these whales and available evidence suggests that killer whales are unlikely to detect and avoid spilled oil and exposure can result in population-level impacts (Matkin et al. 2008). In the event of a spill, the Wildlife Branch Director within the Unified Command (UC) organizational structure will take appropriate action to minimize killer whale exposure to spilled oil. This guidance document provides a range of options that can be considered and implemented.

Permits

Oil spill-related actions involving Southern Resident killer whales are subject to the Marine Mammal Protection Act (MMPA) and the ESA. A permit held by NOAA's Marine Mammal Health and Stranding Response Program covers oil spill-related actions under the MMPA and ESA provided NOAA is involved in the Wildlife Branch during an oil spill and approves any hazing operations for marine mammals prior to implementation during oil spill response.

Reconnaissance

Mapping of current or most recent killer whale sightings by location and direction of movement will be done by the Wildlife Branch's Wildlife Reconnaissance Group. Reconnaissance group members should be able to appropriately distinguish a killer whale from Dall's porpoise and other cetaceans. In an effort to locate killer whales, regional sighting networks and acoustic arrays that are used to track killer whale location and movement can be consulted (Table 1). Once whales are located, a possible maximum sustained killer whale travel speed of 10 mph can be incorporated with whale direction of travel, the tide, wind direction and spill location to predict potential contact with a spill and to estimate time available to mobilize hazing efforts. It should be understood that whales can and usually do travel at slower speeds than this. Time permitting reconnaissance crews should identify killer whales to ecotype (southern resident, transient, offshore), pod and individual or collect data that will allow for this identification at a later date. This can be done visually or acoustically and might require reconnaissance team

training prior to an oil spill. Table 2 has a list of organizations with expertise to identify killer whales to ecotype, pod and individual in real time or from photographs and recordings.

Deterring whales from a spill

The Wildlife Branch's Marine Mammal Hazing Unit will determine if resources can be mobilized to deter whales from entering a spill. The effectiveness at deterring killer whales from entering an oil spill is directly related to the degree to which the whales are attracted to an area (actively feeding vs. transiting) versus the degree of noxious stimuli. Most known hazing techniques utilize negative acoustic or mechanical stimuli. The element of surprise must be employed and it should be considered that whales are capable of habituating to hazing techniques, potentially limiting their long-term repeat effectiveness. There is no one hazing technique that will work in all situations and the potential benefit of employing a technique will be a product of the current circumstances, how the technique is employed, the experience of the people employing the technique and the degree to which whales are attracted to an area.

Because risk of killer whale exposure to oil must be considered relative to the risk associated with hazing and this risk will vary depending on the situation, a prioritized list of hazing options could not be compiled. Instead, the Wildlife Branch, in consultation with NOAA National Marine Fisheries Service will recommend to Unified Command which killer whale hazing techniques, if any, should be used. Potential deterrent options were evaluated by whale experts and oil spill response personnel (see More Detailed Information below) and are listed with their associated positive and negative benefits to provide a range of options to be considered under the circumstances. In addition to weighing the hazing options provided, the Wildlife Branch also must consider the costs and benefits associated with taking no hazing action.

Close-range hazing techniques

- Oikomi Pipes: Oikomi pipes are reverberant metal; usually a pipe with a cap on the top. A handle on the top of the pipe and a cone at the bottom of the pipe improves reverberation. When numerous pipes are used in multiple lines, they have been effective at moving killer whales at close range.
    - Advantages: Oikomi pipes have been used and are very effective at herding whales. This is safe for the whales and would have a high public acceptance level.
    - Disadvantages: This technique would be most effective for herding of animals and might not be as efficacious for keeping animals out of a very large area (such as in the middle of Juan de Fuca Strait). Deployment requires coordination of multiple vessels and could be dangerous at night or during poor sea conditions.
- Seal control devices: These are explosive devices that put out a pulse of noise and previously were used effectively to drive whales during the live captures in Puget Sound in the 1970's.
    - Advantages: They worked from about 1 mile away during whale captures. They are not very expensive and readily available.
    - Disadvantages: There could be concerns about using these explosive devices where highly volatile oil was located. These could cause fish mortality.
- Acoustic Deterrent Devices (ADDs) : ADDs make sound not loud enough to cause pain, but which is audible to marine mammals. ADDs are often called net pingers.
    - Advantages: They are readily available and could be easily deployed on oil booms or vessels.
    - Disadvantages: They may not have sufficient power to deter whales and whales may habituate quickly.

- Killer Whale Calls: Prerecorded calls can be played from a small boat to theoretically either attract whales away from an area or deter them from entering an area.
    - Advantages: Prerecorded calls and broadcasting equipment are readily available and could be deployed from a highly mobile small vessel. This is not dangerous to whales or other species in the area. This technique needs further study.
    - Disadvantages: There have been no rigorous studies showing that calls will consistently cause whales to avoid or be attracted to the source. It is likely that animals could habituate to this relatively quickly.
- Vessel Traffic: The noise and motion of boat traffic could be used drive whales from an area or deter them from entering one.
    - Advantages: Small boats are potentially available for this activity.
    - Disadvantages: Boats have very little value in long-range displacement of killer whales, especially the highly conditioned southern resident killer whales.
- Aircraft: Helicopters can generate a fair amount of noise and wave movement at close range and could produce a startle or avoidance response.
    - Advantages: This might be very effective initially because whales are not used to it. It can be quickly mobilized and could provide real-time tracking of whales. Also, it could simultaneously be used to deploy additional deterrent devices such as seal control devices.
    - Disadvantages: There is no guarantee that helicopters will be able to control whale movement and whales would likely habituate to helicopters quickly. Because of the above-water nature of this deterrent it would affect the behavior of birds and other animals in a way that might not be beneficial (i.e. scare birds off un-oiled shorelines with the chance they will land in oiled areas). If helicopter hazing were used in combination with other hazing methods, such as launching of explosives, then this would require the development of specific safety protocols and perhaps special safety equipment such as a launcher.
- Fire hoses: Fire hoses could be used to direct streams of water at whales on the surface at extremely close range.
    - Advantages: Boats could be equipped with pumping capacity and deployed on fairly short notice. High powered fire monitors mounted on some regional tug boats can send a stream over water over 100 yards.
    - Disadvantages: There are no data on the effectiveness of this technique and it is limited to very close range (approximate 100 yards).
- Strobe lights, bubble curtains, booms or other experimental methods: Theoretically these could provide a visual deterrent and perhaps prevent killer whales from entering a spill.
    - Advantages: Theoretically these could be used to fence off an area without risk of physical harm to the whales.
    - Disadvantages: Light and other visual stimuli will not penetrate water very far and no data are available on effectiveness. Similarly responses to bubble curtains and booms are not quantified.

Longer-range techniques

- Acoustic Harassment Devices (AHDs): AHDs produce noise loud enough that they are likely to cause pain in animals at a certain range (ADDs are not loud enough to cause pain, but can be heard). Airmar AHDs have a source level of 195 dB re 1 μPa_{RMS} and their peak energy at 10 kHz with higher harmonics. These are used at the Ballard Locks and they could be moved at low speed from small boats or could be hull mounted on boats to allow faster movement.

They are designed with 4 transducers that alternate transmission. They can be battery operated, but need a continuous power source for long-term use.

  - Advantages: It would not take long to train people to use them. They may deter killer whales up to 3 km away. This would be publicly acceptable at long range because it is estimated that injury would not be likely at distances over 10 meters.
  - Disadvantages: The received levels needed to cause deterrence without acoustic trauma are unknown, however it is thought that killer whales react strongly at the 135 dB re 1 μPa_{RMS} received level. Additionally, it has been suggested that repeated exposures to AHD's in the same area could result in long-term displacement of killer whales from an area (Morton and Symonds 2002).

- Air guns: This is a mechanical device that uses air that expands and contracts to give a strong pulse under water to map earthquake faults or for oil exploration. They are frequently used in arrays to give a higher source level. Depending on the size, the peak energy can be from 10 Hz to 1 kHz, but they produce broadband pulses with energy at frequencies ranging to over 100 kHz. The higher frequencies are less intense and attenuate faster. Intensity of output is controllable by the operator to account for distance from the subject.
  - Advantages: Harbor porpoise have been seen moving away from them at 70 km so they could have impacts at great distances.
  - Disadvantages: Because mysticetes hear low frequencies better, there is more concern with their use around mysticetes than odontocetes. There are no data on effectiveness in deterring killer whales. These are generally a towed array that is deployed behind a ship like the University of Washington's *R/V Thomas Thompson* so securing a ship to tow the array could be an issue. Use of a single gun would not pose this problem. There is concern about acoustic impacts to killer whales and other species including fish.
- Mid-frequency sonar: This has caused behavioral changes in killer whales in Haro Strait during the *USS Shoup* transit episode in 2003. The source level was approximately 235 dB (exact level is classified) and frequency was 2.6-3.3 kHz over 1-2 second signals emitted every 28 seconds.
  - Advantages: Mid-frequency sonar could be effective for over 25 km, which could be useful in a large spill and it can be operated at night.
  - Disadvantages: Received levels that were effective in causing a response during the USS *Shoup* incident are unknown. There are a very limited number of boats that have the capability to deploy this sonar and they are engaged in national security missions. Concerns with using sonar include the potential for acoustic trauma in killer whales and other marine mammals and a lower level of public acceptance as a deterrent device. Difficulty in limiting range makes this technique excessive for a small spill.

Strandings

Regional marine mammal stranding networks should be alerted by NOAA Fisheries that a spill has occurred and that strandings should be reported directly to the Wildlife Branch via the 1-800 Hotline number activated during the spill. If a carcass is found and the Wildlife Branch authorizes necropsy, protocol should follow the established killer whale necropsy protocol (Raverty and Gaydos, 2004), NOAA's Marine Mammal Oil Spill Response Guidelines (Johnson and Ziccardi, 2006) and be coordinated with NOAA.

Available Equipment and Resources

In addition to personnel and regional sighting networks, a variety of physical resources from boats to Oikomi pipes and seal control devices are available for use by the Wildlife Branch. A list of resources that have been volunteered for this purpose can be found in Table 3.

More Detailed Information

This appendix was drafted from information gathered at a meeting jointly hosted by NOAA/NMFS, Northwest Region and the SeaDoc Society, a program of the UC Davis Wildlife Health Center, School of Veterinary Medicine. Detailed meeting notes including literature cited are available at: http://www.seadocsociety.org/files/pdfs/KW-Oil-Spill-Meeting-Notes.pdf

TABLES 1-3

These resource lists are provided for the use of the Wildlife Branch and NOAA after activation through the Incident Command structure.

Table 1: Regional whale sighting networks

Resource	Phone Number	Contact Person
BC Cetacean Sighting Network	(866) I-SAW-ONE	
Cascadia Research Collective	(800) 747-7329 or (360) 943-7325	John Calambokidis, Erin Falcone or Robin Baird
Center for Whale Research	(360) 378-5835	Ken Balcolmb
Fisheries & Oceans Canada – British Columbia Marine Response Network	(800) 465-4336	Marine Mammal Incident Coordinator
Lifeforce Whale and Dolphin Hotline	(604) 649-5258	Peter Hamilton
Northwest Fisheries Science Center	(206) 860-3220	Brad Hanson or Dawn Noren
Orca Network	(360) 678-3451	Susan Berta or Howard Garrett
Whale Museum Sighting Hotline and acoustic array	(800) 562-8832	Jenny Akinson or Amy Traxler
Whale Watch Operators Association Northwest	(250) 686-4886 (cell) or (250) 658-2778 (office)	Dan Kukat, President

Table 2: Groups or Individuals who are able to identify killer whales to ecotype, pod and individual

Name	Contact Number
Cascadia Research Collective	(360) 943-7325
Center for Whale Research	(360) 378-5835
Department of Fisheries and Oceans	(250) 729-8375
Lifeforce Foundation	(604) 649-5258
Northwest Fisheries Science Center	(206) 860-3220
Whale Museum	(800) 562-8832

Table 3: Resources available for deterring killer whales from an oil spill

Resource	Location	Contact Name	Contact Number
Oikomi Pipes (12)	NOAA Sand Point Facility	Brent Norberg or Lynne Barre	(206) 526-6550 or (206) 526-4745
Seal Control Devices	NOAA	Brent Norberg or Lynne Barre	(206) 526-6550 or (206) 526-4745
AHDs and ADDs	NOAA	Brent Norberg or Lynne Barre	(206) 526-6550 or (206) 526-4745
44' shallow draft boat with licensed captains and capabilities for safe use 24-7 (including night vision capability and underwater speakers with onboard amplifiers)	Global Research and Rescue	Bob Wood	(206) 954-5192
27’ Pacific aluminum skiff with center console	NOAA/NWFSC, Seattle	Dawn Noren	(206) 302-2439
26’ Olympic XL boat with cabin and cockpit	SeaDoc Society, Orcas Island	Joseph Gaydos	(360) 376-3910 or (360) 914-1083
24’ ProLine center console boat	NOAA	Brent Norberg or Lynne Barre	(206) 526-6550 or (206) 526-4745
19’ SAFE Boat	Whale Museum	Jenny Akinson	(800) 562-8832
18' rigid-hulled inflatable boats (n=2)	Cascadia Research, Olympia	John Calambokidis, Erin Falcone or Robin Baird	(360) 943-7325 or (360) 280-8349
18’ Campion boat with 150 HP outboard, large open cockpit with optional full canvas camper cover.	Lifeforce Foundation, Vancouver, BC	Peter Hamilton	(604) 649-5258
Killer Whale Call Recordings	Center for Whale Research	Ken Balcomb	(360) 378-5835
Killer Whale Call Recordings	Department of Fisheries and Oceans, BC	John Ford	(250) 729-8375
Underwater Playback Systems (n=2) and Killer Whale Call Recordings	Lifeforce Foundation, Vancouver, BC	Peter Hamilton	(604) 649-5258
Numerous boats of varying size	Whale Watch Operators Association Northwest	Dan Kukat, President	(250) 686-4886 (cell) or (250) 658-2778 (office)